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ABSTRACT

This paper argues that Mandarin Chinese has a fixed syllabic represented by the template CGVX, with one slot in the onset and three slots in the rimeprime (as projection of the rime). It claims that the pre-nucleus glide is obligatory, is an independent constituent, and is adjoined to the rime constituent. Extensive evidence for this template is drawn from an analysis of derived mid vowels, distributional constraints on syllable structure, reduplication in language games, and rhyming in contemporary poetry and folksong. It remains to be shown whether all Chinese dialects share this same template. Contains 21 references. (MDM)

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ON THE REPRESENTATION OF MANDARIN SYLLABLE STRUCTURE

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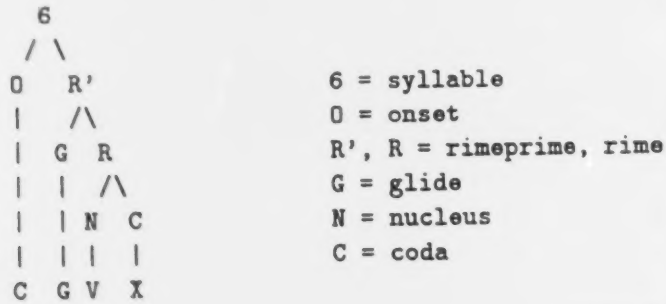
Abstract: Duanmu (1990) argues that all Chinese dialects have a uniform syllabic structure of CVC. In his proposal, the pre-nucleus glide is part of the onset, where CG is a complex segment C^G. In this paper, I propose that Mandarin has a fixed syllabic template of CGVX, with one slot in the onset and three slots in the rimeprime (as projection of the rime). I claim that the pre-nucleus glide is obligatory, is an independent constituent, and that the pre-nucleus glide is adjoined to the rime constituent. Extensive evidence for this proposed template will be drawn from the analysis of derived mid vowels, distributional constraints on syllable structure, reduplication in language games, and rhyming in contemporary poetry and folksong.

1 Introduction

Mandarin is a language of monosyllabic morphemes. Studies of its syllable structure are seen in R. Cheng (1966), Fudge (1968), Chao (1968), C. Cheng (1973), Lin (1989), Bao (1990) and Duanmu (1990).[1] In this paper, I argue that Mandarin has a fixed syllabic structure of four slots, one in the onset and three in the rimeprime, as seen in (1).

(1) The Fixed Syllabic Structure of Mandarin



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I argue that the fixed syllabic skeleton triggers three processes.[2] First, if the coda is not filled, the nuclear segment will spread to the coda, creating a long vowel. Hence, vowel length is predictable in Mandarin. Second, if the onset is not filled, then the following conventions are available to satisfy the obligatory onset requirement: (i) spread the nuclear segment (if [+high] or syllabic nasal) to the onset, (ii) spread the pre-nucleus glide to the onset, (iii) associate the pre-nucleus glide onto onset position, or (iv) the onset is specified as what is commonly called the 'zero onset', which I represent by the symbol #. Third, if the pre-nucleus glide position is not filled, then the glide position is specified as ϕ, a null segment, by default. The analysis of these three processes follows from the analysis of fixed syllable structure in Mandarin, as argued in the following sections. Specifically, I claim that in Mandarin:

(2) a. Every rime has two X slots.
b. Every syllable has an obligatory onset.
c. Every syllable has an obligatory pre-nucleus glide.

Evidence for (2) comes from duration of the rime, suffixation processes, reduplication, and distributional constraints on syllable structure.

The phonetic inventories in Mandarin are as follows.

(3) Consonant Inventory:

p	p^h	m	f	
t	t^h	n		l
ts	ts^h		s	
ʈʂ	$ʈʂ^h$		ʂ	ɻ
tɕ	$tɕ^h$		ɕ	
k	k^h		x	(#)

(4) Vowel Inventory: (6 = schwa)

i	ü	I	u
e		6	o
		a	

The Rime has two X Slots: The fact that no segment can follow a VG sequence within any syllable in Mandarin shows that there are at most two weight-bearing slots in the rime. In addition, when the diminutive suffix /r/

is added to a syllable, as in (5), it replaces the original coda, instead of concatenating to the original syllable, also suggests that every Mandarin syllable has a fixed weight of two slots in the rime (cf. Chao (1968), Duanmu (1990)).

(5) Mandarin Diminutive Suffixation
ya + r ⟶ yar
yan + r ⟶ yar (*yanr)
gwa + r ⟶ gwar
gway + r ⟶ gwar (*gwayr)

A third argument for the fixed rime weight is found in Howie (1976) and Duanmu's (1990) studies; all regular Mandarin syllables have similar duration, which indicates that the rime has a fixed weight.[3] For example, the fact that /ta/, /tan/, /tau/, and /tiau/ have similar duration suggests that the vowel in an open syllable is long. Duanmu (1990) shows that vowel length is predictable, and that the long vowel in an open syllable is the result of spreading to the vacant 2nd rime position. The fact that the existence of the pre-nucleus glide does not affect the duration of the whole syllable when followed by VX sequence, along with the pattern seen in (5), shows that the pre-nucleus glide is not a weight-bearing unit.

Obligatory 'Zero Onset': According to Chao (1968), and Duanmu (1990), Mandarin syllables that are not written with an onset have a 'zero onset'. If the syllable nucleus is a high vowel [i,u,ü], or the syllabic nasal [m], then the zero onset is [y w ÿ m] respectively. However, I make a stronger claim, that syllable-initial glides also can spread onto onset position, or can be mapped onto onset position. This will be seen in the evidence from reduplication in section 3. If there are no [+high] segments in the nucleus or pre-nucleus position, or no syllabic nasals in the nucleus position, then the zero onset has the following four variants:[4]

(6) a. velar nasal [ng]
b. velar or uvular unaspirated fricative/continuant [ɾ]
c. glottal stop [?]
d. glottal unaspirated continuant [H] (which Chao calls a 'true vowel' onset).

Apart from the questions of why these four variants are selected, and what the relationship between these variants is, I agree with Duanmu that the zero onset is not a phonetically motivated phenomenon as is the case in English. Rather it is a phonologically motivated phenomenon. Its presence

prevents the resyllabification of the [-high] nucleus vowel with the preceding coda in pronunciation as shown in (7).

(7) /mian ao/ ---> 'cotton coat'
a. [myan ʔaw]
b. [myan ˥aw]
c. [myang ˧aw]
d. [myang ngaw]
e.*[mya.naw]
(Duanmu (1990:20))

In this paper, I argue that the zero onset phenomenon does not result from an obligatory condition, but rather results from a principle with fixed parametric variations across dialects. I term this the Onset Satisfaction Principle (hereafter OSP). The evidence for this principle comes from the observation of the behavior of the pre-nucleus glide in GV syllables in various language games, and in rhyming. The Onset Satisfaction Principle adopted here is stated in (8). The details of this principle, as it applies in various language games, are considered below in section 3.

(8) Three Parameters of Onset Satisfaction Principle
a. Spread [+high] from the nucleus or pre-nucleus segment onto the onset position, otherwise specify the zero onset #.
b. Insert the zero onset # in every vowel initial syllable.
c. Associate the front glide [y] onto onset position in GV syllables.

The Mandarin-based language games: May-ka, Mey-ka, and Man-t'a are languages which utilize clause (a) of the OSP to satisfy the onset requirement.[5] Taiwanese and Taiwanese-based language games are instances of languages which make use of clause (b) of the OSP to meet the obligatory onset requirement.[6] An example which uses clause (c) of the OSP can be found in Mo-pa, a Kushan-based language game.[7]

Obligatory 'Zero Glide': In this paper I argue that every syllable in Mandarin has an obligatory glide, and that the 'zero glide' phenomenon is phonologically motivated.[8] Specifically, its presence prevents violations of the Labial Constraint in syllables such as /bu/ and /pu/, as discussed in section 2. The zero glide also helps explain a seeming asymmetry between the front glides [y,ÿ] and the back glide [w] in reduplication and language games, as discussed in section 3. In addition, it explains why rhyming between [aw] and [yaw], and between [ÿan] and [an] are possible, as will be discussed in section 5. I propose that the pre-nucleus glide position can be filled only by [+high] segments or by the spreading of [+high] segments; in the absence of a [+high]

segment, the default ϕ, a null segment, is inserted to fill the syllable template.

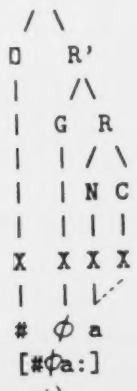
Given a string, along with my proposed syllable template, I assume the following syllabification (template mapping) algorithm:

(9) a. Link the most sonorant segment to the nucleus.
b. Link the onset if there is [+cons] segment available.
c. Link the coda.
d. Link the pre-nucleus glide.
e. If the coda is not filled, spread the nuclear segment to it.
f. If the onset is not filled, consult the OSP to insert a segment into it.
g. If the pre-nucleus glide position is empty, insert the default zero glide ϕ.

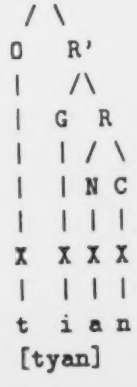
For the following 4 representative syllable types in Mandarin, my proposed syllabification algorithm will assign the syllable representations as shown in (11).

(10) a. /a/ 'filthy' b. /tian/ 'heaven'
c. /i/ 'clothes' d. /ian/ 'smoke'

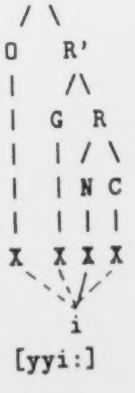
(11) a.



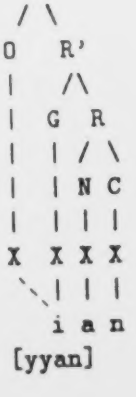
b.



c.



d.



(# = zero onset)

More arguments for the status of the pre-nucleus glide and my proposed syllable structure will be drawn from the analysis of derived mid vowels, distributional constraints on syllable structure, reduplication and language games, and rhyming in poetry and folksongs.

Analysis of Derived Mid Vowels: In Mandarin, the mid vowel /6/ acquires its [back] (and [round]) specification from an adjacent glide on either side. If glides are present on both sides, then it assimilates to the segment on the right (the coda) (cf. C. Cheng (1973)).

(12) Distribution of Mid Vowels

a. /b6i/ ⟶ [bey] 'cup'	/bi6/ ⟶ [bye] 'separate'
b. /t6u/ ⟶ [tow] 'steal'	/tu6/ ⟶ [two] 'delay'
c. /di6u/ ⟶ [dyow] 'throw'	/tu6i/ ⟶ [twey] 'withdraw'

With the syllable structure in (1), I can account for the pattern of assimilation by stating that the mid vowel assimilates to the structurally closest segment. Under this formulation, directionality of assimilation needs not be stipulated.

I turn next to the distributional constraints on labial and back segments in section 2. Section 3 sketches reduplication patterns seen in the various Fanqie languages: Mo-pa, May-ka, Mey-ka, Na-ma, and Taiwanese. Section 4 points to several problems in Duanmu's (1990) and Bao's (1990) analyses. Sections 5 demonstrates how rhyming in poetry and folksongs, provides some insight to the status of the pre-nucleus glide and the syllable structure of Mandarin. Some residual problems are addressed in the concluding section.

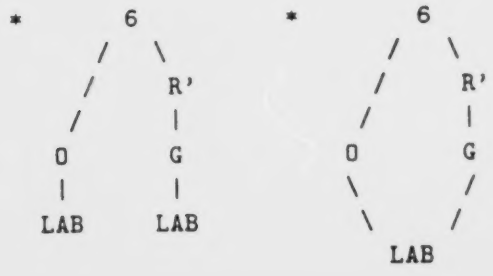
2 Distributional Constraints on Syllable Structure

If the pre-nucleus glide is part of the onset, I would expect there to be some co-occurrence restrictions for consonant clusters in the onset position. However, I find almost all kinds of consonants freely occurring before the front glide [y]. Before the back glide [w], only labial consonants are prohibited. The data in (13) illustrate the relevant distribution of the consonants before the two glides. I argue that labial consonants are disallowed before the back glide [w] due to the Labial Constraint. My proposed Labial Constraint is given in (14).

(13) Data Showing Distribution of Labial Segments:

a. labials			
byan	'change'	pyan	'cheating'
myan	'noodle'	*fyan[9]	
*bwan	*pwan	*mwan	*fwan
b. dentals			
tyan	'heaven'	dyan	'shop'
nyan	'read'	lyan	'in love'
twan	'fast stream'	dwan	'hold'
nwan	'warm'	lwan	'twin'
c. palatals			
jyan	'sharp'	qyan	'money'
xyan	'thread'[10]		
d. velars			
gwan	'close'	kwan	'wide'
hwan	'happy'		

(14) The Labial Constraint



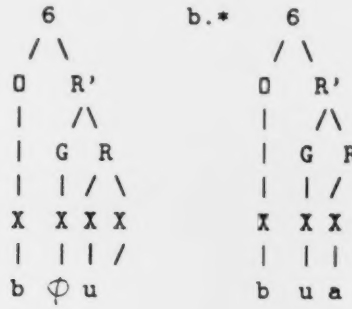
The Labial Constraint says that the onset and the pre-nucleus glide of a syllable can not both be labials, no matter what kind of linking to the Labial node is. The Labial Constraint allows the occurrence of the following labial sequences.

	a. bu	pu	mu	fu
(15)	b. baw	paw	maw	fow

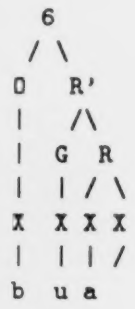
The Labial Constraint directly explains why the forms in (15b) are good, and why *bwan, *pwan, etc. are bad. As for the forms in (15a), I argue that the presence of the zero glide ϕ prevents these forms from violating the Labial Constraint. Therefore, the forms in (15a) are well-formed. In my

analysis, /bu/ and */bua/ have the following syllabic representations:

(16) a.

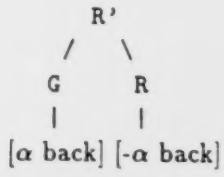


b.*



In addition to the Labial Constraint, which holds between the onset and the pre-nucleus glide due to **string adjacency**, I find that there is a co-occurrence restriction holding between the pre-nucleus glide and the rime. If there are three elements within the rime constituent (R'), then the pre-nucleus glide and the post-nucleus glide must have opposite specifications for backness (cf. C. Cheng 1973). In this paper, I give a formal representation of the back dissimilation constraint described by Cheng, given in (17). I argue that the co-occurrence restriction between the pre-nucleus glide and the post-nucleus glide is better expressed as a co-occurrence restriction between the pre-nucleus glide and the rime (R), due to **structural adjacency**.

(17) The Back Dissimilation Condition



The relevant data for the ill-formed patterns *yVy and *wVw are shown in (18).

(18) Data Showing Back Constraint:

a. *bwaw	*pwaw	*mwaw	*fwaw
b. *dwaw	*twaw	*gwaw	*kwaw
c. *bwow	*pwow	*mwow	*fwow
d. *dwow	*twow	*gwow	*kwow
e. *byay	*pyay	*myay	*fyay
f. *dyay	*tyay	*gyay	*kyay
g. *byey	*pyey	*myey	*fyey
h. *dyey	*tyey	*gyey	*kyey[11]

These examples motivate my proposed Back Dissimilation Condition. Here I assume that the low vowel /a/ and the mid vowel /6/ are not specified for the feature [back]. Recall that the mid vowels [e] and [o] are derived from /6/. Therefore, the redundancy rules supplying the feature [+back] must apply after the Back Dissimilation Condition applies. The matrix in (19) shows the underspecified representation of the vowels in Mandarin.

(19) Distinctive Feature Specification: (6 = schwa)

	i	u	u	6	a
back	-	-	+		
round		+	+		
high	+	+	+		
low					+

Redundancy Rules:
[ ] --> [+back]
[ ] --> [-round]
[ ] --> [-high]
[ ] --> [-low]

The advantage of the Back Dissimilation Condition is that I can account for the non-occurrence of the patterns *wVw, and *yVy by a single constraint. Also, the benefit of my proposed obligatory zero glide is that it accounts for the previously unexplained exception of the lexical item [yay] 'cliff' to the Back Dissimilation Condition (cf. Hockett (1947), Fudge (1968), Cheng (1973), and Fu (1990)). I argue that the representation for the lexical item 'cliff' is [yϕay]. Therefore there is no violation of the Back Dissimilation Condition.

It is interesting to find that the Back Dissimilation Condition functions

in another Chinese dialect: Kejia (cf. Chung (1988)). The Back Dissimilation Condition predicts that the combinations in (20) are all ungrammatical in Kejia.[12] Notice that the mid vowels in Kejia appear in underlying vowel inventories, and so are specified for the feature [back].

(20)

*yey	*waw
*yay	*wow
*ye	*wo

Further support for the obligatory zero glide, the Back Dissimilation Condition and the Labial Constraint will be seen in section 3, where reduplication and language games are discussed. It seems to me that the Back Dissimilation Condition is not an accident; rather it is a systematic restriction on the syllable structure of languages such as Mandarin, Kejia, and Fanqie languages.

3 Language Games and Reduplication

In this section, I bring in evidence from language games, known as Fanqie languages, to provide insight to the status of the pre-nucleus glide and the syllable structure of Mandarin (and possibly other Chinese dialects as well). Here I adopt Steriade's (1988) model of reduplication. She argues that reduplication is a process of total copying of the base, followed by insertion or truncation, which operates on the string derived through the total copying of the base. The various Fanqie languages are formed by a process of full reduplication, followed by language-specific conventions of inserting some segmental material into some prosodic constituent(s).

There are three possible ways to incorporate the pre-nucleus glide into syllable structure: (i) make it part of the onset, (ii) make it part of the rime, and (iii) make it an independent constituent. I argue that the facts of reduplication can be used to determine the syllable constituency of the pre-nucleus glide. If insertion into the onset causes the substitution of the pre-nucleus glide, the simplest analysis would take the pre-nucleus glide to be part of the onset. If insertion into the rime causes substitution of the pre-nucleus glide, the simplest analysis would take the pre-nucleus glide to be part of the rime. If neither onset insertion, nor rime insertion cause substitution of the pre-nucleus glide, then the simplest analysis would take the pre-nucleus glide to be an independent constituent.

The differing status of the pre-nucleus glide can be seen from three representative Fanqie languages of Chinese: Mo-pa, May-ka, and Na-ma. In

Mo-pa, the pre-nucleus glide behaves as part of the rime. In May-ka, it manifests itself as an independent constituent. In Na-ma, it functions like part of the onset. I argue that, in the various language games, the pre-nucleus glide always appears as an independent constituent, which is adjoined to the rime.

My solution to the reduplication patterns seen in these three Fanqie languages will mainly rely on the independent status of the pre-nucleus glide, the richer syllable structure, and the Onset Satisfaction Principle to derive the correct output.

Mo-pa: Mo-pa is a language game based on the Kunshan dialect. When insertion operates on the rime of the first syllable, it causes the substitution of the pre-nucleus glide. This suggests that the pre-nucleus glide is part of the rime. I suggest the rules as shown in (21) for Mo-pa and a sample derivation is given in (22) for illustration.

(21) a. Reduplicate the syllable.
b. Insert [ϕo] into the first rime (R').
c. Switch the value of [cont] of the second onset.

(22) lyā
lyā-lyā (21a)
lϕo-lyā (21b)
lϕo-tyā (21c)
output: lϕo-tyā[lo-tyā]

Consider an instance of a GV syllable from Mo-pa. My analysis for the example /iO/ 'want' from Chao (1931) is given in (23).

(23) iO
yϕO (OSP, clause (c): associate [y] onto onset position)
yϕO-yϕO (21a)
yϕo-yϕO (21b)
yϕo-tʂϕO (21c)
output: yϕo-tʂϕO[yo-tʂO]

In Mo-pa, I find that the front glide [y] in a GV sequence is mapped onto onset position, due to clause (c) of the OSP. Unfortunate ly, Chao (1931) does not include any data beginning with the back glide [w] in a GV sequence. Therefore it is hard to know whether [w] in a GV sequence in Mo-pa

is mapped onto the onset position. However, the OSP gives me the correct output for the above example. As we go on, we will find that the OSP is a principle with fixed parametric variations across dialects.

May-ka: May-ka is a language game based on Mandarin. When insertion operates on the rime of the first syllable and the onset of the second syllable, it does not cause the substitution of the pre-nucleus glide in either syllable. This indicates that the pre-nucleus glide has an independent status in the syllable. I suggest the following rules and derivations for May-ka.

(24) a. Reduplicate the syllable.
b. Insert [ay] into the first rime (R).
c. Insert [k] into the second onset.

(25) hwey
hwey-hwey (24a)
hway-hwey (24b)
hway-kwey (24c)
output: hway-kwey

(26) lya
lya-lya (24a)
lyay-lya (24b)
lyay-kya (24c)
lye-tɕya (Repair and Palatalization)[13]
output: lye-tɕya

Consider two examples of GV syllables from May-ka, one beginning with the front glide [y], and the other with the back glide [w]. For the example /iang/ 'sun', I propose the analysis in (27). Again, it is crucial to make reference to the OSP in my analysis.

(27) iang
yyang (OSP, clause (a): spreading)
yyang-yyang (24a)
yyay-yyang (24b)
yyay-kyang (24c)
yye-tɕyang (Repair and Palatalization)
output: yye-tɕyang[ye-tɕyang]

Notice that after the application of (24c), there is a process I term Repair

involved in the derivation in (26) and (27). I suggest the Repair rule: ay ⟶ e / y__ for May-ka, where [y] is in the pre-nucleus position. I argue that the motivation for this rule is due to the Back Dissimilation Condition proposed earlier in this paper. I find that this constraint is not only respected in Mandarin, but also in the language game May-ka.

In accounting for GV syllables beginning with the back glide [w], I need to consider an additional Mandarin rule which changes [w] in syllable initial position to [v].[14] In Duanmu (1990), this rule is taken to be obligatory and is carried over to May-ka. However, in order to account for the data in Chao (1931), I must follow Yip (1982) and Bao (1990) in assuming that this rule is optional. This allows the following two analyses for the example /uan/ 'curve'.

(28) uan
wwan (OSP: spreading)
wɸan (Repair: due to violation of the Labial Constraint)[15]
vɸan (rule w → v)
vɸan-vɸan (24a)
vɸay-vɸan (24b)
vɸay-kɸan (24c)
output: vɸay-kɸan[vay-kan]

(29) uan
wwan (OSP: spreading)
wɸan (Repair: due to violation of the Labial Constraint)
wɸan-wɸan (24a)
wɸay-wɸan (24b)
wɸay-kɸan (24c)
output: wɸay-kɸan[way-kan]

Notice that in (28) and (29), there is another Repair rule involved in the derivations. I suggest the Repair rule: w ⟶ ɸ / w __ for Mandarin and May-ka. I argue that the motivation for this Repair rule is due to the Labial Constraint proposed earlier in this paper. In proposing this additional Repair rule, my analysis explains a seeming asymmetry between the front glide and the back glide, where the front glide [y] surfaces in the pre-nucleus position of the second syllable, but the back [w] does not. My analysis requires invoking the Onset Satisfaction Principle and the Labial Constraint to account for this type of data. I argue that the pre-nucleus glide can be a potential onset through spreading. May-ka, like Mandarin, spreads [+high] segments to the

onset position to meet the requirement of the Onset Satisfaction Principle. This analysis accounts for both kinds of output.

I turn now to Mey-ka, another Fanqie language based on Mandarin, which shows similar phonological patterns to May-ka.

Mey-ka: Mey-ka is another Mandarin-based language game, which provides further support for my proposed Back Dissimilation Condition and the Onset Satisfaction Principle. I suggest the following rules for Mey-ka and some derivations are seen in (31) through (33).

(30) a. Reduplicate the syllable.
b. Insert [ey] into the first rime (R).
c. Insert [k] into the second onset.

(31) lya
lya-lya (30a)
lyey-lya (30b)
lyey-kya (30c)
lϕey-kya (Repair: due to violation of the Back Dissimilation Condition)[16]
output: lϕey-kya[ley-kya]

(32) iang
yyang (OSP: spreading)
yyang-yyang (30a)
yyey-yyang (30b)
yyey-kyang (30c)
yϕey-kyang (Repair)
output: yϕey-kyang[yey-kyang][17]

(33) hwey
hwey-hwey (30a)
hwey-hwey (30b)
hwey-kwey (30c)
output: hwey-kwey

In comparing (25) through (29) with (31) through (33), I find that although May-ka and Mey-ka are both based on the same source language, Mandarin, they differ in the strategies that they employ to repair the ill-formed syllables that are produced by reduplication and the insertion of segmental material. In May-ka, [ay] is changed to [e] when preceded by the

the front glide [y], whereas in Mey-ka, the front glide [y] gets deleted. I suggest the Repair rule: y $\longrightarrow \phi$ / __ Vy for Mey-ka. The motivation for the [y] deletion in Mey-ka, seen in (31) and (32), again comes from the Back Dissimilation Condition. Again, I utilize the OSP to derive correct output for the glide-initial syllable in Mey-ka. Thus the output form in (32) is not an exception to the Back Dissimilation Condition. Rather, the presence of the zero glide causes the output to conform to the Back Dissimilation Condition.

Na-ma: In the Na-ma case, after the insertion of segmental material into the first onset, the pre-nucleus glide is lost in the output, which suggests that the glide is part of the onset. Such cases provide a challenge to any analysis which assumes that the pre-nucleus glide is part of the rime. In this section, I demonstrate that my analysis is able to handle this phenomenon. The rules for Na-ma are shown in (34) and a derivation is given in (35).

(34) a. Reduplicate the syllable.
b. Template for the first syllable of the redupicant: CVX
c. Insert [n] into the first onset.

(35) twey
twey-twey (34a)
tey-twey (34b)
ney-twey (34c)
output: ney-twey

The formulation of (34b) suggests prosodic circumscription operates on the first syllable of the reduplicant.

Taiwanese: To complete my proposed Onset Satisfaction Principle, I introduce another Fanqie language, which is based on Taiwanese. According to the description of Li (1985), all vocalic-initial syllables in Taiwanese have a zero onset #, which has only one phonetic alternant; i.e., the glottal stop [?]. The fact that when insertion operates on the onset, the pre-nucleus glide remains intact suggests that the glide belongs to the rime. The rules and examples for the Taiwanese-based language game can be seen in (36) through (38).

(36) a. Reduplicate the syllable.
b. Insert [l] into the first onset.
c. Insert [i] into the second nucleus (or rime).[18]

(37) Taiwanese-based Language Games:

	(36a)		(36b)		(36c)	
kun	⟶	kun-kun	⟶	lun-kun	⟶	lun-kin
sat	⟶	sat-sat	⟶	lat-sat	⟶	lat-sit
a	⟶	a-a	⟶	la-a	⟶	la-i
e	⟶	e-e	⟶	le-e	⟶	le-i
ỹā	⟶	ỹā-ỹā	⟶	nỹā-ỹā	⟶	nỹā-ĩ[19]
hwe	⟶	hwe-hwe	⟶	lwe-hwe	⟶	lwe-hi
tsya	⟶	tsya-tsya	⟶	lya-tsya	⟶	lya-tsi
tsay	⟶	tsay-tsay	⟶	lay-tsay	⟶	lay-tsi
t^haw	⟶	t^haw-t^haw	⟶	law-t^haw	⟶	law-t^hi
tsyaw	⟶	tsyaw-tsyaw	⟶	lyaw-tsyaw	⟶	lyaw-tsi
k^hway	⟶	k^hway-k^hway	⟶	lway-k^hway	⟶	lway-k^hi[20]

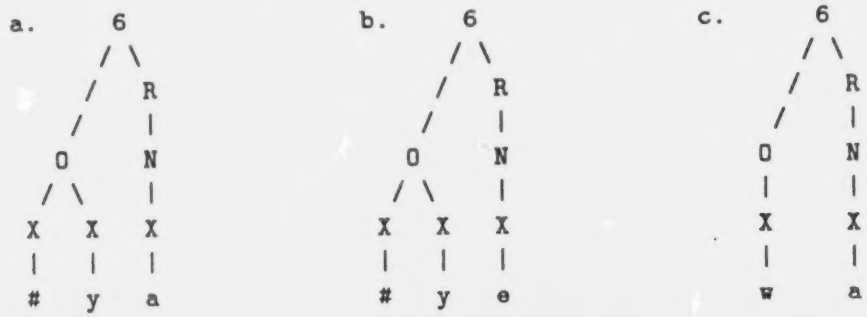
In summary, I have shown that the Onset Satisfaction Principle plays an important role in accounting for glide-initial words in Fanqie languages. My analysis suggests that all the Fanqie languages employ the same Fanqie rules: full reduplication and constituent modification. However, they may differ in the parametric invoking of the OSP, and in which constituent is chosen for insertion of segmental material. Data from various Fanqie languages investigated here support my claim that the pre-nucleus glide is a part of the rime. The benefit of my analysis is that there is just one single syllable structure required for both the base language and its corresponding Fanqie language(s).

4 Previous Analyses

In this section I present the analyses proposed by Bao (1990) and Duanmu (1990), and then discuss the differences between their and my analyses.

Bao's Analysis: Bao (1990) argues that different Chinese dialects can have different syllable structures, and that there is not a fixed template for syllable structure within a single dialect.[21] He proposes that the pre-nucleus is part of the onset, where the CG sequence is a consonant cluster in Mandarin and Mandarin-based Fanqie languages. In his analysis, different pre-nucleus glides have different syllable status when they occur in syllable-initial position. Therefore, /ya/ 'crow', /ỹ6/ 'moon', and /wa/ 'frog' have the following syllable representations.

(38) Bao's Syllable Representations: (Bao 1990:334)



Based on these assumptions, he can account for the following patterns shown in the language games of May-ka and Mey-ka.

(39) May-ka
wan
wan-wan (Reduplication)
way-wan (Replace the first rime with [ay])
way-kan (Replace the second onset-initial with [k])
output: way-kan

(40) May-ka
lya
lya-lya (Reduplication)
lyay-lya (Replace the first rime with [ay])
lyay-kya (Replace the second onset-initial with [k])
lye-kya (Repair and Palatalization)
output: lye-tɕya

(41) May-ka
yang
#yang
#yang-#yang (Reduplication)
#yay-#yang (Replace the first rime with [ay])
#yay-kyang (Replace the second onset-initial with [k])
#ye-tɕyang (Repair and Palatalization)
output: #ye-tɕyang[22]

(42) Mey-ka

lya
lya-lya (Reduplication)
lyey-lya (Replace the first rime with [ey])
lyey-kya (Replace the second onset-initial with [k])
ley-kya (Repair)
output: ley-kya

(43) Mey-ka

#yang
#yang-#yang (Reduplication)
#yey-#yang (Replace the first rime with [ey])
#yey-kyang (Replace second onset-initial with [k])
———— (Repair: Not applied)
output: #yey-kyang

Bao proposes the Repair rule: ay → e / y __ for May-ka, and the Repair rule: y → ϕ / __ ey for Mey-ka which are the same as the two Repair rules I propose in section 3. He argues that the application of the two Repair rules is due to the fact that Mandarin does not allow the form CyVy, and the same kind of constraint is carried over to the Mandarin-based language games: May-ka and Mey-ka. Though he does not spell out what kind of constraint it is, I find that his argument indicates that it is in essence comparable to my proposed Back Dissimilation Constraint. However, his analysis provides no explanation for why [#yay] 'cliff' is well-formed in Mandarin, why [#yey] in Mey-ka does not undergo the Repair rule, or why [#yay] in May-ka does undergo the Repair rule. It must be stipulated that the lexical item [#yay] is an exception to the back constraint, and it also must be stipulated that the front glide [y] is not deleted when preceded by the zero onset #. This raises the question of whether the zero onset # really behaves differently from a regular onset.

Bao also notes that the back glide [w] has several free phonetic variants, ranging from [w] to [v], when it occurs in syllable-initial position, whereas the front glide [y] always remains stable and preserves its glide status. Bao claims that these facts indicate that they have different phonological behaviors. In comparing Bao's analysis with my analysis seen in (26) through (29) and (31) through (32), my analysis differs from Bao's analysis in two ways: (i) my analysis accounts for the distribution of [back] segments in Mandarin, and the application of the two Repair rules in May-ka and Mey-ka in a principled way: by making reference to the OSP, the Back Dissimilation Constraint and the insertion of the zero glide; and (ii) with reference to the OSP, the Labial Constraint and the insertion of the zero glide, my analysis does not

postulate any asymmetrical behavior between the two kinds of glides.

Another major problem for Bao's proposal is that his analysis allows substitution to operate on **part of a prosodic unit**, which is contrary to the spirit of Steriade's (1988) claim, in this case, the first member of the Onset. His analysis predicts that substitution can also operate on the second member of the Onset. However, such kind of case is never attested.

Duanmu's Analysis: Duanmu (1990) argues that all Chinese dialects have a uniform syllabic structure of three slots, one in the onset and two in the rime. He proposes that the pre-nucleus glide is part of the onset where CG is a complex segment C^G. In his analysis, both front glides and back glides in syllable-initial position are in the onset position.

In dealing with language games, since C^G is a complex segment, Duanmu's analysis relies on the notion of what he termed Feature Recycling to get back the secondary articulation that was lost after substitution operates on the onset constituent.[23] However, his analysis has difficulties in accounting for the following data of May-ka. Note that the parenthesis indicates that the old segmental material still hangs around even after insertion of new segmental material.

(44) May-ka	wan	
	van	(rule w → v)
	van-van	(Reduplication)
	vay(an)-van	(Replace the first rime with [ay])
	vay(an)-k(v)an	(Replace the second onset with [k])
	vay-kan	(Feature Recycling)
	output: vay-kan[24]	

In (45) I find that if the optional rule w → v /# __ does not apply, then the incorrect output *[way-k^{w}an], instead of the correct output [way-kan], is derived in Duanmu's analysis.

(45) May-ka	wan	
	wan-wan	(Reduplication)
	way(an)-wan	(Replace the first rime with [ay])
	way(an)-k(w)an	(Replace the second onset with [k])
	way-k^{w}an	(Feature Recycling)
	output: *way-k^{w}an	

In (46) and (47) we see that by not recognizing the back constraint as the driving force for the Repair rule, Duanmu's analysis fails.[25] The correct output for (46) should be [lᵛe-tɕᵛa], whereas the correct output for (47) should be [ye-tɕᵛang]. In comparing Duanmu's analysis with my analysis in (26) and (27), we find that the Back Dissimilation Constraint and the Repair rule are what we need, in order to account for this type of data.

(46) May-ka

lya	
lᵛa-lᵛa	(Reduplication)
lᵛay(a)-lᵛa	(Replace the first rime with [ay])
lᵛay(a)-k(lᵛ)a	(Replace the second onset with [k])
lᵛay-kᵛa	(Feature Recycling)
lᵛay-tɕᵛa	(Palatalization??)[26]
output: *lᵛay-tɕᵛa	

(47) May-ka

yang	
yang-yang	(Reduplication)
yay(ang)-yang	(Replace the first rime with [ay])
yay(ang)-k(y)ang	(Replace the second onset with [k])
yay-kᵛang	(Feature Recycling)
yay-tɕᵛang	(Palatalization??)
output: *yay-tɕᵛang	

In (48) through (50) we see examples of Duanmu's proposal applied to Mey-ka. Duanmu proposes that Onset Simplification is a mechanism that various language games can utilize to delete the minor articulator of a complex segment, in order to derive the correct output. He argues that Mo-pa is one of the languages that makes use of the Onset Simplification.[27] However, we find Onset Simplification can not be applied straightforwardly in Mey-ka. In (50), after the application of Onset Simplification, the incorrect form *[hey-kʷey] is derived. One possible solution is to stipulate that Onset Simplification only targets the front glide. In this case, Duanmu provides no principled explanation for the asymmetry between the two glides. In comparing Duanmu's proposal applied to Mey-ka with the analysis I presented in (30) through (33), there is no need to appeal to the notion of Feature Recycling, nor the mechanism of Onset Simplification in my analysis.

(48) Mey-ka

$l^{y}a$	
$l^{y}a$-$l^{y}a$	(Reduplication)
l^{y}ey(a)-$l^{y}a$	(Replace the first rime with [ey])
l^{y}ey(a)-k(l^{y})a	(Replace the second onset with [k])
l^{y}ey-$k^{y}a$	(Feature Recycling)
ley-$k^{y}a$	(Onset Simplification)[28]
output: ley-$k^{y}a$	

(49) Mey-ka

yang	
yang-yang	(Reduplication)
yey(ang)-yang	(Replace the first rime with [ey])
yey(ang)-k(y)ang	(Replace the second onset with [k])
yey-k^{y}ang	(Feature Recycling)
————	(Onset Simplification: not applied)
output: yey-k^{y}ang	

(50) Mey-ka

h^{w}ey	
h^{w}ey-h^{w}ey	
h^{w}ey(ey)-h^{w}ey	
h^{w}ey(ey)-k(h^{w})ey	
h^{w}ey-k^{w}ey	(Feature Recycling)
hey-k^{w}ey	(Onset Simplification)
output: *hey-k^{w}ey	

In summary, by appealing to my proposed OSP and the Labial Constraint, my analysis is able to account for the free variation between [vay-kan] and [way-kan] seen in (28) and (29). In addition, by recognizing the independent status of the pre-nucleus glide and the Back Dissimilation Condition, there is no need to appeal to the notion of Feature Recycling, nor to appeal to the mechanism of Onset Simplification. My analysis can account for all the data investigated here without any ad hoc stipulations. In addition, my analysis is able to maintain a symmetry in the phonological behavior of the glides.

5 Rhyming in Poetry and Folksongs

In this section, I will demonstrate that rhyming in poetry and folksongs reveals the status of the pre-nucleus glide, based on native speakers' identification of the rhymes. In Mandarin, two syllables rhyme if they share the same nucleus and coda. Wang (1973) claims that poetic rhyme does not include the pre-nucleus glide. I tested this hypothesis against native speakers' judgments in identifying rhymes, but found, constrary to Wang, that

the pre-nucleus glide is part of the rime. Consider the following poem and folksong.

(51) yi ken tsi t̪su t̪si myaw **myaw**
song key baw baw t̪swo kwan ɕyaw
ɕyaw er twey t̪seng kow, kow er twey t̪seng ɕyaw
ɕyaw zhong tɕʰwey tɕʰw ɕin ʂin **tyaw**
ɕyaw baw baw, yi ti yi ti ɕw̃ey xwey lyaw, ɕw̃ey xwey lyaw

'There is a piece of bamboo that is very straight.'
'Give it to the kid to make a flute.'
'Put the flute right in front of your mouth, put your mouth right in front of the flute.'
'Make a new popular song out of it.'
'Little kid learns to make the new song little by little, learn how to.'

In this folksong, the last word of each line rhymes. Among the twelve speakers tested, two of them characterized the rhyming constituent as [aw], four of them chose [yaw], and the rest recognized both [aw] and [yaw] as rhyming constituents. The traditional account of rhyming maintains that the pre-nucleus glide is outside the rhyming constituent. This account explains the first set of speakers. However, since for a large number of speakers, the pre-nucleus glide is a part of the rhyming constituent, it is necessary to identify a syllable constituent that includes the glide and the syllable rime. This constituent is R' in my proposed syllable structure. By identifying the constituent R' in addition to the constituent R, I can account for the first set of speakers by saying that for them, rhyming is scanning the R node (loose rhyme) alone. I am also able to account for the second set of speakers by saying that rhyming is scanning the R' node (strict rhyme), instead of the R node. As for the third set of speakers (most speakers), the free variation between [yaw] and [aw] follows naturally from my proposal that the pre-nucleus glide is an independent constituent, which is part of the rime. If the pre-nucleus glide belongs to the onset, then one has to explain how [yaw] can be a rhyming constituent. Note that onset features never count in rhyming. The diagram in (53) shows the speakers' intuition on this folksong.

(52)

rhyme	aw	yaw	aw/yaw
speaker	A	C	G
	B	D	H
		E	I
		F	J
			K
			L

Now let's look at a poem in which the syllables contain different pre-nucleus glides.

(53) tɕyan li jye lyang ÿȳ**an**
bu fu shi tshi **fan**
hong nyang ɕi tɕyan ɕyan
ÿüe law lay tsheng **tɕȳan**

'We have the chance to know each other, though we live far away.'
'It's worth it to know each other.'
'It's the matchmaker who makes us know each other.'
'It's Cupid who puts us together.'

For this poem, speakers had different intuitions from the first folksong. Among the same twelve speakers, six of them identified the rhyme as [an] (every line rhymes), two of them chose [ȳan] (only the first line and the last line rhymes), the other four recognized a gradient rhyme. Among the last four speakers, two feel that the first line and the last line rhyme closely, while the second line is okay as a rhyme. However, for the other two speakers, the first line and the last line are the best match, while the third line is also an acceptable rhyme. To account for the above four possibilities for rhyming, the only solution is to recognize the pre-nucleus glide as an independent constituent, which is part of the rime. For the first set of speakers, if there are different pre-nucleus glides present, rhyming only scans the R node. For the second set of speakers, rhyming always scans the R' node, so only syllables with exactly the same pre-nucleus glide can rhyme. The intuitions of the third set of speakers offers some support for the zero glide ϕ. From the first folksong, we find that the rhyming constituent for speaker F is R'. In this poetry, we find that for this same speaker, the rhyming constituent still is the R' node, therefore, [ȳȳan] and [tɕȳan] are the best match. The reason that [fan] is okay as a rhyme is because its surface representation is [fϕan], while [ɕyan] is not okay as a rhyme is due to the fact that the pre-nucleus glide [y] is distinct from the other glide [ȳ]. From the first folksong, we find

that the rhyming constituent for speaker L can be R or R'. This is consistent with his intuition in identifying the rhyme in this poetry. If the rhyming constituent is the R node, then the rhyme is [an] as predicted. If When the rhyming constituent is the R' node, the rhyme is identified as [ȳan] is also as predicted. The intuition of the last set of speakers, which overlaps to some extent with that of the third set of speakers, has implications for the current feature theory. The intuition of the last set of speakers suggests that labiality (or the feature [round]) is a secondary articulatory feature for vowels. For this set of speakers, two syllables may rhyme if they have the same pre-nucleus glide (in addition to having the same nucleus and coda), or if they have pre-nucleus glides with same specification for the feature [back]. Therefore, [ÿȳan] strictly rhymes with [tɕȳan] and loosely rhymes with [ɕyan], but does not rhyme with [fan], [wɸan], or [dwan]. However, the latter three syllables do rhyme with each other. These results all support my proposal that pre-nucleus glides are in the rime. The following diagram shows the speakers' intuitions on this poetry.

(54)

rhyme	an	ÿan	ÿan/an	ÿan/yan
speaker	A	C	F	E
	B	D	L	K
	G			
	H			
	I			
	J			

To test native speakers' intutitions more accurately, I designed an experiment in which I presented each speaker with a song I constructed especially to probe properties of poetic rhyme. In this song, there are three occurrences of the pre-nucleus glide *y*, three occurrences of the pre-nucleus glide *ȳ*, three occurrences of the pre-nucleus glide *w*, three occurrences of words without any pre-nucleus glides, and also three occurrences of words that do not rhyme.[29]

(55) qing piao piao de giou shi guang giou zhe me liou zow
zhuan tou huei qū kan kan shi yi shu **nyan**
shi guang liou zhuang you duo sao bian **hwan**
fen bie hou si nian duei gi zai xin **kan**
tian ya hai giao ci qing he yi **gan**
ye ceng pan wang ÿe lao lai cheng **qȳan**
bu zhi suei ÿe neng fou ba si nian chong **dan**
hai shi yi ba ta bian zuo xi **gwan**

cang mang mang de tian ya lu shi ni de piao bo
gu dan dan de shen ying hou shi wo ji liao de xin qing
zuo ye meng li qing qing ba shou **wan**
wu liou liou de hei yan zhu he ni de xiao **lyan**
ni de shen ying bu duan di zai huei **xȳan**
ru he ye nan wang ne rong **yan**
he shi cai neng ȳe ÿan ren **ȳan**

'Time just flies.'
'It's been several years, now I look back.'
'Since then, how many changes there are.'
'I kept thinking of you after we separated from each other.'
'How can I stand this feeling that's with me wherever I am.'
'I have wished that Cupid could put us together.'
'But can time reduce my feelings toward you?'
'Or does time ingrain my feelings toward you?'
'Now you wander around the world.'
'I also feel alone and lonely.'
'Last night, I dreamed of holding your hands.'
'I saw your dark pretty eyes and your smiling face.'
'I kept seeing you in the dreams.'
'How can I ever forget your face?'
'When can we truly come together?'

Among ten of the same speakers as in the previous tests, one identified the rhyme as [an], and three identified four rhyming groups: [an], [ÿan], [yan], and [wan]. Two recognized two rhyming groups: [an] and [wan] fall into one group, and [yan] and [ÿan] fall into a second group. Four chose a gradient rhyme; they feel that it is better to identify four rhyming groups: [an], [ÿan], [yan], and [wan], but it is acceptabl to choose [an] as the only rhyme. To account for the above four possibilities for rhyming, it is necessary to recognize the pre-nucleus as an independent constituent, which is adjoined to the rime.

A second kind of support for my hypothesis that the pre-nucleus glide is part of the rime, comes from Kejia, where the rhymes in the folksongs do not include the pre-nucleus glide (cf. R. Chung (1988)). However, Kejia differs from Mandarin in that two syllabl es can not rhyme if they contain different pre-nucleus glides. This gives support for my proposal that the pre-nucleus glide is part of the rime. If the pre-nucleus glide is in the onset, then one has to explain why syllables with different pre-nucleus glides can not rhyme.

The strongest counterargument to the idea that the pre-nucleus glides are part of the onset comes from Taiwanese. In Taiwanese, syllables with pre-nucleus glides seldom rhyme with those without the pre-nucleus glides, nor do they rhyme with those with different pre-nucleus glides (cf. Li (1986), Chang (1980)). If we recognize that pre-nucleus glides are part of the rime and recognize that there are two kinds of rhyming in Chinese, which we term "loose" and "strict" rhyming, then we can account for the different behaviors of the pre-nucleus glides in the different dialects. By proposing an independent constituent of R', we are able to set up the rhyming parameters for Chinese dialects. I argue that pre-nucleus glides are optional in rhyming in Mandarin, but obligatory in Taiwanese. Thus rhyming in Mandarin scans either the constituent R, or R', but rhyming in Taiwanese always scans the constituent R'.

6 Residual Problems

I have argued that pre-nucleus glides are part of the rime by drawing evidence from the distribution of mid vowels, distributional constraints on labial segments and back segments, language games, and rhyming. I find that Mandarin has a fixed syllabic structure of four slots, one in the onset and three in the rime. It remains to be shown whether all Chinese dialects share this same syllabic template.

A second question arises concerning the phonological status of the obligatory zero glide. The presence of this zero glide accounts for the Mandarin Labial Constraint without resorting to stipulatory device. It also accounts for the well-formedness of the lexical item /iai/ 'cliff' (with a surface representation of [yϕay]), which appears in Mandarin and Mandarin-based Fanqie languages, without resorting to exceptions to the Back Dissimilation Condition. In addition, it explains the behavior of both kinds of pre-nucleus glides in the Fanqie language of Mey-ka, without assuming that they have asymmetrical behavior, as Bao and Duanmu do. However, I do not see evidence of this sort in other dialects. Is the existence of the zero glide a special property of Mandarin and Mandarin-based Fanqie languages? I will leave these questions for future research.

NOTES

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[1] Note that the major difference between the proposal of Cheng (1973), Lin (1989), following the traditional syllable representation, and my proposal lies in that I claim that Mandarin has a fixed syllabic template of CGVX, instead of a canonical form, allowing one to maximally five segments

[2] Howie (1976) and Duanmu (1990) argue for the first process. Chao (1968) and Duanmu (1990) argue for (i) and (iv) of the second process. The arguments for the third process and for (ii) and (iii) of the second process are the contributions of this paper.

[3] However, in a weakened syllable, its duration is about 50% of that of a regular syllable. See Duanmu (1990) for more discussion of a weakened syllable.

[4] In my dialect, Mandarin spoken in Taiwan, only (6c and d) are possible variants of the zero onset for syllables with a [-high] nucleus. See Duanmu (1990) for detailed discussion of the zero onset.

[5] There is no data beginning with nonhigh vowels in Chao (1930), which should potentially give some insight to the 'zero onset' phenomenon.

[6] According to Li (1985), the zero onset in the Taiwanese Fanqie language has just one phonetic realization, i.e. the glottal stop [?]. This is true for every vowel-initial syllable. Taiwanese is unlike Mandarin, in that the Mandarin zero onset has four variants, and the Mandarin [+high] can spread onto the onset position.

[7] See section 3 for a more detailed description of a GV syllable in Mo-pa. Note that Chao (1930) does not include any data beginning with [w] for Mo-pa.

[8] Chao (1968, 18-23) divides the Mandarin syllable into four components, 'initial', 'medial', 'vowel' and 'ending', and suggests that initialless syllables have the 'zero initial', medialless syllables have the 'zero medial', and endingless syllables have the 'zero ending'. However, Chao does not provide explicit arguments to support his analysis.

[9] The non-occurrence of */fyan/ is probably just an accidental gap.

[10] Palatals are derived from velars, so palatals and velars are in complementary distribution.

[11] Note that /ũai/ ([ỹay]), and /ũei/ ([ỹey]) are not possible sequences either. Lin (1989) proposes two labial co-occurrence restrictions for Taiwanese, one operating on the syllable as a whole, and the other operating within the rime. Cheng (1989) and Duanmu (1990) criticize Lin's analysis, in that a syllable like *[kwaw] is ruled out twice. The same kind of criticism applies to my analysis, since a syllable like *[mwaw] is ruled out once by my proposed Labial Constraint, and again by the Back Dissimilation Condition. My point is that this type of ill-formed syllable is ambiguous, in that it is possible that both constraints are violated.

[12] This constraint also holds between the nucleus and the coda in Kejia in the case of a VG sequence. This constraint then precludes the following VG sequences in Kejia.

*ey *ow

In Cantonese, Kejia and Taiwanese, the mid vowels [e] and [o] appear in the underlying vowel inventory. Therefore, they are specified for the feature [back]. Thus, the fact that the combinations of [ye] and [wo] are bad in Kejia and Taiwanese is predicted by this constraint. However, it is not clear why [wo] is well-formed in Cantonese. Duanmu (1990) suggests that the two Labial nodes in this case merge into one, so that there is no violation of his proposed Round Constraint. We must then ask why merger does not operate in either Kejia, or Taiwanese. The two mid vowels [e] and [o] are derived from /6/ in Mandarin, and so are not specified for the feature [back]. They acquire their [back] and [round] specifications from [+high] neighboring segments, labial consonants, or from the default rule: [ ] → [+back]. Therefore, the combinations of [ye] and [wo] are good in Mandarin.

Note that coda consonants behave differently from post-nucleus glides in both Kejia and Taiwanese, where consonants are specified for the feature [back], and the nuclear vowel agrees with the coda consonant in [back] specification. For example, [ong], [ok], [ung], [ep], [ip], [im], and [em] are good combinations in Kejia, but *[om], *[op], *[um], *[up], *[ing], *[ik], *[eng], and *[ek] are all bad combinations. One could argue that the first four bad combinations are due to some type of Labial constraint, but it would be hard to account for the last four without resorting to some other device. See Chung (1988) for more detailed discussion. See also Chen (1990) for discussion of the different behavior of coda consonants and post-nucleus glides with respect to reduplication in secret language (Fanqie language) formation in Taiwanese.

Lin (1989) argues that the Final, which is equivalent to my proposed constituent R', is a domain for the Labial co-occurrence restriction and some other co-occurrence restrictions in Taiwanese. She finds that a high back vowel can not be followed by a velar consonant, therefore *[uk], and *[ung] are disallowed. The same kind of constraint also holds between the pre-nucleus glide and velar consonants in the coda, so that *uak and *uang are not allowed. She also finds that [ku] 'to squat' is well-formed in Taiwanese is because the two labial segments are not within the Final. However, she does not spell out what kind of constraint bans the combination of high back vowels and velar consonants. Here, I suggest that it is the same kind of Back Dissimilation Condition which operates within the R' as in Mandarin.

Nevertheless, it is not clear whether we can dispense with the Labial Constraint in favor of the Back Dissimilation Condition as the only constraint for Taiwanese, Kejia and Mandarin. The other alternative is to dispense with the Back Dissimilation Condition, and appeal to the Labial Constraint (Duanmu's Round Constraint) as the only constraint for these languages. This is exactly the approach Duanmu (1990) pursues. However, this proposal is not satisfactory either. For example, he must stipulate a restriction that primary labials (labial consonants) can not bear the feature [+round], in order to account for the badness of *[b^{w}a], *[b^{w}an], etc. in Mandarin. Similarly, he can account for the badness of *[uam], and *[uap] for Taiwanese, but only at the cost of stipulating [p] and [m] as secondary labials that bear [+round] specification in the coda position, so that the Round Constraint is violated. This stipulation is not otherwise motivated for Taiwanese. The same criticism can apply to Duanmu's analysis of Cantonese, in which he rules out *[wam], *[k^{w}am], *[wip], and *[k^{w}ip] by saying that [p] and [m] are secondary labials in coda position.

[13] /kya/ is realized as [tɕya] as the result of palatalization. Besides palatalization, there are two other modification rules:
(24b') Insert a different tone onto the first rime (R), in case the first syllable of the output is totally identical to the base form (input).
(24c) Insert [l] into the second onset if the second onset of the input begins with [k].

[14] The rule w ⟶ v/#__ does not operate in all dialects.

[15] Another possibility would be to modify my proposed OSP so that any [+high] segment will be associated to the onset position first, then spread [+high] onto the pre-nucleus glide position, respecting the Labial Constraint. In that case, the Labial Constraint is formulated such that it can block the spreading of [+high] onto the pre-nucleus glide position.

[16] Note that May-ka and Mey-ka also differ in the application of palatalization. In Mey-ka, palatalization does not apply.

[17] Note again that Chao (1930) does not include any data beginning with [w] in GV syllables for Mey-ka. The advantage of my analysis is that I capture the generalization that the front glide [y] in syllable-initial position behaves the same in both May-ka and Mey-ka. As will be seen in (41) and (43), Bao's analysis provides no explanation for why the the same front glide has different behavior when preceded by the zero onset #.

[18] Data from the Taiwanese-based Fanqie language suggests that the coda consonant is outside the domain of application of substitution. Bao's proposed syllable structures given below in footnote 21, are consistent with the patterns observed in this Fanqie language. However, at this point it is still not clear whether substitution operates on the nucleus or on the rime constituent. What is certain is that substitution targets all the vocalic elements in a syllable, including both pre- and post-vocalic glides. It would require further study on other phonological processes to decide what the syllable structure is for this particular language.

[19] In this type of example, [n] shows up in the onset of the first syllable instead of [l], due to spreading of the nasal feature from the following vowel. [ĩ] shows up in the nucleus position of the second syllable because of nasality stability effect.

[20] There is no example beginning with [w], nor with a single vowel /i/ or /u/ as the only element in a syllable in Li (1985). However, there is another Taiwanese-based Fanqie language where the rules are: a. Reduplicate the syllable. b. Replace the onset of the second syllable with [l]. Here, I do find examples with /i/ or /u/ as the only element in the syllable besides the zero onset. For example, /i/ becomes as [?i-li] in this Fanqie language, while /u/ becomes [?u-lu].

[21] Bao (1990) proposes different syllable structures for different dialects. He claims that the pre-nucleus glide is part of an onset cluster in Mandarin, while it is part of the rime in dialects such as Mo-pa and Taiwanese. He proposes the the following two syllable structures for Taiwanese.

[22] Bao (1990) criticizes Yip's (1982) analysis, in that Yip derives correct output for [wan] and [yang] by associating [w] with a C slot, but associating [y] with a V slot. But nothing in Yip's theory can prevent associating [w] with the V slot, but associating [y] with the C slot. In the latter case, both of the ill-formed outputs *[way-kwan], and *[ye-kang] are derived. Note that Yip assumes that Mandarin and the Fanqie languages have a fixed skeleton CGVC, but allows some slots to be unfilled. She does not refer to syllable structure in her analysis.

[23] The following is Duanmu's formulation of Feature Recycling (Duanmu 1990:57):
a. Features and/or articulators in a floating/replaced segment may be reattached (i.e. recycled) to a nonfloating segment, without changing the existing features and articulators in the latter.
b. Which articulators/features to recycle is a language particular option.
c. Feature Recycling observes the phonotactics of the language in question.
d. Feature Recycling is local.

[24] Note that rule ordering is crucial in Duanmu's analysis. The w ⟶ v/#__ rule must apply before reduplication and substitution in order to derive the correct output. Otherwise, the incorrect output *[vay-k^{w}an] will be derived, since Feature Recycling will reattach the [+round] of the floating [w] back to the onset [k]. In contrast, there is no need to order the w → v rule before reduplication in either Bao's or my analyses.

[25] Duanmu (1990) does not recognize any back constraint for Mandarin. He believes that since [yay] 'cliff' is possible, the absence of CyVy is due to a gap. Duanmu (1992) (p.c.) suggests that he could also have a back constraint, encoded at the syllable node. In this case, however, his analysis would still suffer the same criticism as Bao's, sketched in section 4 where Bao's analysis is discussed. It seems that any analysis assuming that the pre-nucleus glide is part of the onset will have difficulties in accounting for glide-initial syllables in the language games.

[26] It's not straighforward to derive Palatalization in Duanmu's system.

[27] Duanmu (1990) suggests the following rules for Mo-pa and gives the derivation for [l^{y}ã] 'two' (Duanmu 1990:72).
a. Reduplicate the syllable.
b. Replace the first rime with [o]
c. Switch the value of [cont] of the second onset.
d. Simplify the first onset (i.e. delete the minor articulator).

l^{y}ã
l^{y}ã-l^{y}ã (a)
l^{y}(ã)o-l^{y}ã (b)
l^{y}(ã)o-t^{y}ã (c)
l^{y}(ã)o-t^{y}ã (Feature Recycling)
lo-t^{y}ã (d)
output: lo-t^{y}ã

[28] Duanmu does not discuss the case of Mey-ka in his dissertation. However, we may construct an analysis along the lines of his analysis of May-ka. One possibility would be for him to say that there is no Onset Simplification operating in Mey-ka, but that the change from [l^{y}ey] to [ley] is due to Repair. Then he must account for why [yey] is good. This is exactly the same kind of dilemma he faces in his analysis of the Mandarin distribution facts, where he does not want to recognize two co-occurrence restrictions for Mandarin,

namely the Round Constraint and the back constraint. He chooses to say that the absence of *yVy is due to a gap. This raises the question of why the same kind of gap is also observed in other dialects, such as Kejia and Taiwanese. Is this really an accident? No such accidental, systematic gaps are required in my analysis. The other alternative for Duanmu's analysis would be to say that Feature Recycling only recycles [+round], not the feature [-back] in Mey-ka. This implicitly admits the asymmetrical behavior between the two kinds of glides. We mush then explain why the pre-nucleus glides in the two Fanqie languages, May-ka and Mey-ka, based on the same source language Mandarin, have such different behavior.

[29] The methodology of providing equal occurrences of the different pre-nucleus glides in testing native speakers' intuition was suggested to me by Chin-Chuan Cheng.

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